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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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EXAMINER

ROSASCO, STEPHEN D

| ART UNIT | PAPER NUMBER |
|----------|--------------|
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1756

DATE MAILED: 10/11/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/787,118

Applicant(s)

BUTT ET AL.

Examiner

Stephen Rosasco

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 September 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-8 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 February 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
- 1) ☒ Certified copies of the priority documents have been received.
 - 2) ☐ Certified copies of the priority documents have been received in Application No. _____.
 - 3) ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>2/27/04</u> . | 6) <input type="checkbox"/> Other: _____ |

Detailed Action

Claim 1 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The claim recites that -the phase shift mask comprises at least one first pattern, the first pattern being arranged in a two-dimensional matrix with a multiple of second patterns, the second patterns being substantially identical to the first pattern.

The first and second patterns are then indistinguishable. The claim then makes a distinction between -the first pattern including: at least a first portion having i) a first area, and at least a second portion having i) a second area.

And then that the “first and second transmission are different with respect to each other.”

It is unclear where the difference lies in the two “portions” and the two “patterns”.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Haruki et al. (5,637,424) or Sugita et al. (6,534,242) in view of Nakao (5,744,268).

The claimed invention is directed to a phase-shift mask, wherein the relative surface area sizes of portions having distinct phase-shift and transmission of light of a pattern on a phase-shift mask substantially obey the condition that the product of surface area and transmission of the

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electrical field strength is the same for all of the portions. Then, frequency doubling occurs due to vanishing zero order diffraction orders and in the case of high-transition attenuated phase-shift masks a large first order diffraction amplitude reveals an even an improved as compared with conventional phase-shift masks. Two-dimensional matrix-like structures particularly on attenuated or halftone phase-shift masks can be arranged to image high-density patterns on a semiconductor wafer. The duty cycles of pattern matrices can be chosen being different from one in two orthogonal directions nevertheless leading to frequency doubling.

The applicant discusses the limitations of the prior art in that while it is a straightforward approach to apply alternating phase-shifts to transparent portions of the patterns, i.e., spaces, in a one-dimensional grid of structures, i.e., lines and spaces, an application in two-dimensional periodic structures is more complicated. For example, a dense structure matrix of contact holes necessitates, in the case of alternating phase-shift masks, there are always two neighboring contact holes, which in being transparent both comprise the feature of the same phase-shift. The assignment of two phases allows either a maximum contrast in y-direction or a maximum contrast in x-direction, but no simultaneous improvement of the contrast is possible.

Haruki et al. teach a mask for forming a desired pattern on the image plane is divided into a number of cell areas. Each cell is assigned a uniform characteristic. Each cell area is assigned a particular light transmission characteristic to form a starting pattern which may be the desired target pattern itself. The light transmission characteristic of each cell area is changed randomly. The light intensity distribution is simulated to select only the patterns having a good performance. Such characteristic change is continued until the inheritance operation is

converged and a final pattern is obtained. This final pattern is used as the mask pattern. The above process may also be applied to determining the shape of an aperture stop and a light source.

Sugita et al. teach an exposure method for transferring a device pattern to a resist, wherein the device pattern includes a first element and a second element having a linewidth narrower than the first element. The method includes a first exposure step for exposing the resist by use of an interference fringe, produced by interference of two light beams, through an exposure amount substantially not greater than a threshold of the resist, and a second exposure step for exposing the resist with a light pattern related to the first and second elements. A light component, of the light pattern, related to the first element bears an exposure amount greater than the threshold, a light component, of the light pattern, related to the second element bears an exposure amount not greater than the threshold and is to be combined with light in a portion of the interference fringe, and a sum of the exposure amount of the light component related to the second element and an exposure amount provided by the light in the portion of the interference fringe is greater than the threshold.

The teachings of Haruki et al. or Sugita et al. differ from those of the applicant in that they do not teach the rectangular arrangement of the patterns.

Nakao teaches a phase shift mask comprising: a substrate having first, second, third and fourth light transmission regions allowing transmission of exposure light therethrough, having a shield region interrupting exposure light, and provided at a main surface of said third light transmission region with a trench such that a phase of the exposure light transmitted through said

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third light transmission region is different from that of the exposure light transmitted through said first and second light transmission regions;

a semi-shield film formed on the main surface of said substrate for damping the intensity of the exposure light, covering said second and fourth light transmission regions, and exposing said first and third light transmission regions;

a phase shift film formed on the main surface of said substrate, covering said fourth light transmission region and exposing said first, second and third light transmission regions for setting a phase of the exposure light transmitted through said fourth light transmission region to be different from that of the exposure light transmitted through said first and second light transmission regions and to be substantially equal to that of the exposure light transmitted through said third light transmission region; and a shield film formed on the main surface of said substrate, covering said shield region and exposing said first, second, third and fourth light transmission regions.

And wherein said semi-shield film and said phase shift film are formed on the main surface of said substrate at said shield region.

And wherein the main surface of said substrate has first and second plane regions each having a substantially square planar shape;

four shield regions spaced from each other are formed at four corners of said first plane region;

said second light transmission region is arranged at each of areas extending along the four sides defining the planar shape of said first plane region, respectively, and located between said shield regions;

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said first light transmission region is arranged at a substantially central portion of said first plane region and is in contact with each of said second light transmission regions arranged within said first plane region;

four shield regions spaced from each other are arranged at four corners of said second plane region;

said fourth light transmission region is arranged at each of areas extending along the four sides defining the planar shape of said second plane region, respectively, and located between said shield regions; and

said third light transmission region is arranged at a substantially central portion of said second plane region and is in contact with each of said fourth light transmission regions arranged within said second plane region.

further comprising a third plane region on the main surface of said substrate, said first and third light transmission regions in said third plane region extending parallel to each other in a predetermined direction with said shield region therebetween.

Therefore, it would have been obvious to one having ordinary skill in the art to take the teachings of Haruki et al. or Sugita et al. and combine them with the teachings of Nakao in order to make the claimed invention because it is well known in the mask art to make exposed patterns from a mask that is comprised of a grid or matrix like structures.

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Conclusion

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Stephen Rosasco whose telephone number is (571) 272-1389. The Examiner can normally be reached Monday-Friday, from 8:00 AM to 4:30 PM. The Examiner's supervisor, Mark Huff, can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'S. Rosasco', with a stylized initial 'S' and a long horizontal stroke extending to the right.

S. Rosasco
Primary Examiner
Art Unit 1756

S. Rosasco
10/03/05